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### SILVICAL LEAFLET 38.

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#### PAPER BIRCH.

*Betula papyrifera* Marsh.

Paper birch is an important tree in the Northeast, both for economic and for silvicultural reasons. Its total annual cut is not large in comparison with that of many other species, but it is an important factor in certain wood-working industries. It is used practically to the exclusion of other woods in the manufacture of spools, shoe pegs, shoe shanks, and very largely in the manufacture of toothpicks, dowels, bobbins, shuttles, and various toys and novelties. The fine-grained, even-textured wood is peculiarly adapted to these uses.

After fires and clearings, paper birch, with aspen, is often the first species to occupy the ground. It takes possession of such areas very readily, restores forest conditions, and furnishes a valuable timber crop. At the same time, it is merely a temporary type of forest, and does not prevent the return of the type natural to the locality.

#### RANGE AND OCCURRENCE.

The range of paper birch is very wide. It extends from Maine and Labrador northward almost to the Arctic Circle, and westward to the Rocky Mountains and to the valley of the Mackenzie River in British Columbia. It was once thought to be transcontinental, but the western forms are now considered distinct, although closely related species, and are distinguished under the names of *Betula alaskensis*, *Betula occidentalis*, and *Betula andrewsii*. Its southern limits are Long Island, northern Pennsylvania, central Michigan, central Iowa, and northern Nebraska. Its western limits are as yet poorly defined, but it is probable that in the United States this species gradually gives place to the western forms in the Rocky Mountains.

It is not evenly distributed throughout this wide range. In the maritime provinces of Canada and north of the Great Lakes, in parts of the Lake States, and in northern New England it is a common tree, and often forms extensive stands; in the rest of its range it is not abundant, and usually occurs only as scattering individuals. Its local occurrence is determined very largely by fires. Burned areas offer excellent soil and light conditions for its reproduction, and in such situations pure stands of excellent quality are often found. At present, the largest, best, and most accessible stands occur in the Northeast, in a broad belt extending from northeastern New Hampshire eastward across central Maine.

In the important part of its range—that is, in the northeastern part of the United States—there are no great variations in elevation, so that altitude is not an important factor in determining its distribution. It occurs from sea level practically to the timber line in the White Mountains. On Mount Washington it has been found growing as a prostrate shrub at an elevation of 5,700 feet.

#### CLIMATE.

With so wide a geographical range, paper birch is naturally subjected to considerable variation in climate. The maximum temperature is occasionally over 100° F., and during the winter, when the trees are at rest, it endures temperatures lower than -40° F. Late frosts, after growth has started in the spring, sometimes do considerable damage to the tender shoots, and toward the northern limit of its range the short growing season reduces it to a low, scrubby tree, or to a mere shrub. In the eastern part of the United States, however, a period of about four months without frost may be expected during the summer—from the middle of May until the middle of September.

The amount of precipitation received also varies in different localities. In the Northeast it averages from 40 to 50 inches per year, and is well distributed, with no well-marked “dry” and “rainy” seasons. A large part of the precipitation is snow, which melts and becomes available for early growth in the spring. The summer precipitation is also fairly heavy, and the danger from drought is small. Toward the west the precipitation gradually grows less. In Minnesota it averages only 26 inches a year, and this comes mainly in summer. West of there the rainfall is still further reduced, until the more humid climate of the Rocky Mountains is reached, when this species gives way to its western representatives. The semi-humid climate of the Northeast with its abundant atmospheric moisture best meets the requirements of the paper birch, and it is there that it attains its best development.



## ASSOCIATED SPECIES.

In the virgin forest paper birch seldom forms pure stands, but grows in mixture with other species. Its most common associates are spruce, balsam, yellow birch, sugar maple, and beech. It may also be found with all other species having the same range, such as the aspens, red maple, red oak, white and black ash, white pine, and tamarack.

Pure stands frequently originate after fires or clearings, and such stands are now common in parts of the Northeast. They are usually even-aged, and vary in extent from a few to several hundred acres. The trees in such stands are not usually so well developed nor of such good quality as those in mixture with other species, but the stands are more valuable commercially, because they contain more birch per acre, and are, therefore, much more easily and cheaply lumbered. Another forest type commonly found after fires is a mixture of paper birch and "popple," under which term are included both aspen and largetooth aspen. This mixture is also usually even-aged and exhibits many of the characteristics of pure birch stands.

## HABIT.

When it grows in the forest paper birch develops a long, clear bole, with little taper. It is usually free from large branches to a height of 40 or 50 feet. The crown then branches out suddenly and is composed of numerous small branches without any definite central stem. The crown is oval in shape, considerably longer than wide, and usually occupies somewhat less than half the total length of the tree. In the open the form of the tree is very different. The bole is much shorter, tapers more rapidly, and the crown branches out comparatively near the ground. The crown itself is much broader and better developed, and often more nearly spherical in shape.

The root system is comparatively shallow, without any well-developed tap root. It has, however, a considerable lateral extent, and in firm ground supports the tree well.

Mature trees in favorable situations are usually 70 or 80 feet in height, with a diameter of from 10 to 12 inches and a volume of from 18 to 30 cubic feet. Exceptional trees may attain a height of 90 feet and a diameter of 3 feet. In unfavorable situations and near the limits of its range it is much smaller, very branchy, gnarled, and twisted, and often reduced to a mere shrub.

## SOIL AND MOISTURE.

Paper birch reaches its best development on a fresh, well-drained, sandy loam. It likes plenty of moisture, but does not do well in swampy or ill-drained situations. On the other hand, it avoids the very dry

sandy barrens. It has considerable adaptability to different soil conditions, however, and between these two extremes will do well on almost any kind of soil. It is often found on very rocky hillsides, and in the White Mountains it is abundant on thin-soiled, rocky slopes above 3,000 feet. This is not because it prefers such situations, but because it is able to adapt itself to them better than many other species. It requires a fair amount of atmospheric moisture.

#### TOLERANCE.

Paper birch is one of the most intolerant trees in the Northeast. In this respect it is exceeded only by the aspens, among the broad-leaf species with which it associates. In early youth it will grow under a very light shade, but later will stand no overhead shade and but little from the side. Trees which are not fully exposed to the light soon become suppressed, and although they may struggle along for a few years, never develop into healthy, vigorous specimens. Paper birch does not recover well after being released from suppression, as do spruce and balsam. Owing to its intolerance, it prunes itself readily, and its light, thin-foliaged crown casts but little shade. Other more tolerant species are therefore able to come in under it and form a second story. This quality alone gives paper birch a high silvicultural value, since it may be utilized previous to its final harvesting as a nurse crop for other valuable species.

#### GROWTH AND LONGEVITY.

Paper birch is a short-lived tree. Seedlings seldom live more than 120 or 140 years, and sprouts seldom more than 80 years. Seedlings become mature at about 80, and sprouts at 50 or 60 years of age. In both cases these average ages may be considerably reduced in poor localities.

Seedlings and sprouts differ considerably in rate of growth. In early youth sprouts grow much more rapidly than seedlings, but the growth of seedlings is more sustained, and in later life exceeds that of the sprouts. Even in seedlings, however, growth is quite rapid for 45 or 50 years. It then falls off gradually until the trees are mature, when it decreases very rapidly, and in old age is nearly at a standstill. Seedlings and sprouts have nearly the same diameter at about 45 years of age, but after that the seedlings have the advantage. The average height growth of the sprouts exceeds that of the seedlings almost until maturity.

Six inches is the minimum diameter at which paper birch is merchantable. This is attained by seedlings at 35 years of age, and by sprouts between 30 and 35. Nine or ten inches is a much more satisfactory diameter for cutting, however. This size is reached by



seedlings between the ages of 60 and 75 years, when they may be expected to contain from 14 to 19 cubic feet. Sprouts of this diameter are apt to be overmature.

#### SUSCEPTIBILITY TO INJURY.

One of the most serious defects in paper birch is the presence of heartwood, commonly known as "red heart." This is an inferior wood and can not be used with the white sapwood. The amount of heart varies with the age, size, and location of the tree. In favorable situations it seldom appears in seedlings less than 5 inches in diameter, or less than 40 years old. In sprouts it may appear a few years earlier. At first it usually increases in diameter at about the same rate that the tree is growing, but after maturity it spreads rapidly and greatly reduces the value of the tree. It is perfectly sound when it first appears, but is attacked rather readily by rot.

Paper birch is not very susceptible to injuries. It is seldom attacked by insects or fungi, and in spite of its shallow root system, suffers comparatively little from windfall. Its most serious enemy is fire. Light ground fires are sufficient to destroy young stands and often injure older ones on account of the thin and highly inflammable bark. Deer do considerable harm by browsing the young shoots, and sapsuckers occasionally bore holes in the trunk.

#### REPRODUCTION.

Under certain conditions, paper birch reproduces itself abundantly by seed; under other conditions, but poorly. In the virgin forest reproduction is scarce. A few seedlings may occur here and there in openings, but on account of their intolerance they are unable to start even under a fairly open cover. Reproduction within the forest is further limited by the thick layer of humus usually present, since the seeds prefer a bare mineral soil for a germinating bed.

Burned and cleared areas, on the other hand, offer ideal conditions for its reproduction. The bare mineral soil is exposed, and the whole area gets the full benefit of the light. Such areas may be stocked with seed from very distant trees, since the seeds are very light and are equipped with broad, thin, membranaceous wings which enable them to be carried readily long distances by the wind. Well-authenticated instances are on record which show that seeds have been carried several miles in this way. There is, therefore, no necessity for the presence of seed trees in the immediate vicinity of the burned area in order to secure reproduction upon it. Furthermore, paper birch is a prolific seed producer, so that there is almost sure to be an abundance of seed every year. There are no regular seed years, but the seeds are borne annually, with particularly heavy crops at irregular intervals of two or three years. A considerable proportion of this

seed is infertile, however, and under natural conditions only about half of it is capable of germinating. Full-crowned trees, such as grow in the open, produce the most and the best seeds. The root system of the young seedlings is weak and shallow, so that the soil must contain a fair amount of moisture in order to prevent their drying out and dying.

Sprout reproduction from the root collar is also very good in many cases. The chief factors influencing this are the age of the stump and the amount of light it receives. Up to 50 or 60 years of age paper birch sprouts readily; after that it gradually loses its vigor until at maturity it seldom produces healthy sprouts. Trees from 40 to 50 years old may be expected to produce on an average about 46 sprouts per stump, with an average height of slightly more than 2 feet at the end of their first season. The great majority of these sprouts are killed out by competition in early youth, and at maturity there are usually from 2 to 4 stems in one group. The new shoots continue their growth well into the autumn, and are apt to have their tips frost-killed, particularly when the sprouts start in summer. This does not kill the sprout, however, and does comparatively little harm. The same stump can not be coppiced more than three or four times, since it loses its vigor after a few generations of sprouts.

#### MANAGEMENT.

When paper birch occurs in mixture with other hardwoods or with conifers, it is useless to try to secure its reproduction. The best method in such cases is to cull out all of the merchantable birch, with the result that the type is changed and the one natural to the locality is restored. In pure stands if there is an understory of spruce and balsam or of tolerant hardwoods, the case is almost equally hopeless. The ground is already occupied by other species, and there is but little chance for the birch to reestablish itself.

When there is no such understory and but little undergrowth, there is a possibility of securing satisfactory reproduction. On account of the extreme intolerance of paper birch the clean-cutting system must be used; it is also the most natural one to use, because the stands are usually even-aged and nearly all of the trees are merchantable. This will present good light conditions, but the soil conditions are not, as a rule, so favorable for the development of seedlings, and the second growth is likely to be composed largely of sprouts. Often a very good second cut can be obtained in this way, and under exceptionally favorable conditions a third cut, but seldom more. The resulting sprout stands can be managed in the same way, provided the cutting is done when the trees are in their full vigor, although the



system can not be continued indefinitely, because of the exhaustion of the stumps.

The shape and size of the clearing are of little importance. In the humid conditions of the Northeast the soil is not likely to be injuriously affected by large openings, and since sprout reproduction is mainly depended upon, the leaving of seed trees is unnecessary. Plenty of seed to restock such open places as are favorable for its germination will be available from neighboring trees.

The best way to dispose of the tops is to lop them so that the large branches will come into contact with the soil. They will then decay readily, will offer but little danger from fire, and will help to improve humous conditions in the forest.

The important point to emphasize in the management of paper birch is that it is not a permanent type in the forest. It is brought into existence by a change in natural forest conditions, occupies the ground only temporarily, and in time inevitably gives way to the type natural to the locality. While careful management may succeed in securing a second, or even a third cut, it can not continue the type indefinitely. The object of all management should therefore be to utilize the present stand to its fullest extent, and at the same time to leave the forest in the best possible silvicultural condition.

[Leaf. 38]

